Application of Synthetic Aperture Radar Interferometry in Characterizing Ground Subsidence and Defining Earth Fissure Risk

AGIC

2005

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AMEC Earth and Environmental, Inc. and GIS

- Field Data Collection
- Map Data Collection
- Spatial/Data Analysis for Projects
- Map Compilation/Presentation for Projects
- Spatial Data Conversion
- Tabular Data Conversion
- 3D Animation and Visualization
- Remote Sensing

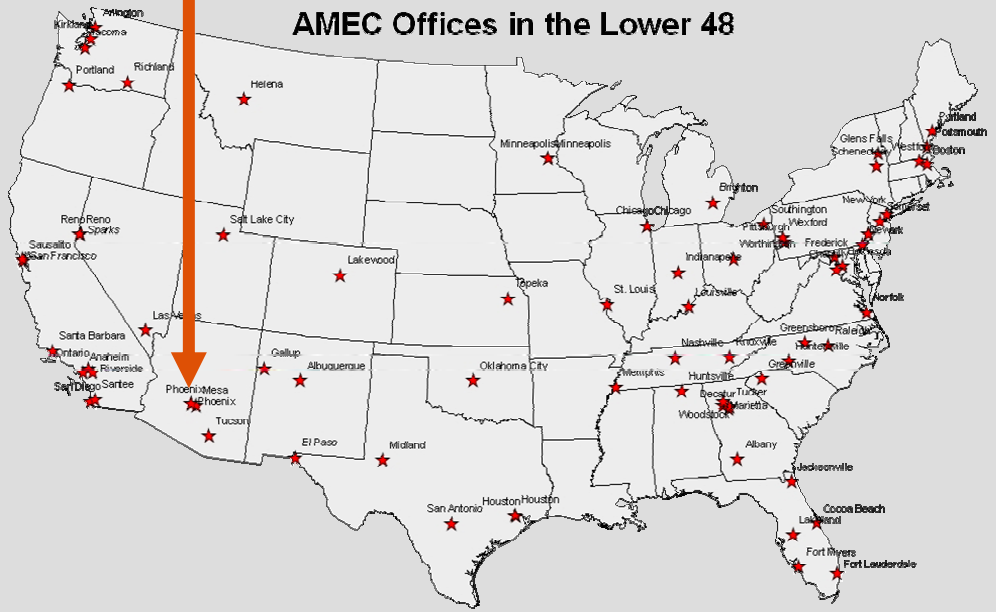
- Strategic Planning
- System Design/Development
  - For internal use
  - For end clients
- System Maintenance
- Training
- Technical Support

1405 West Auto Drive

Tempe, Arizona 85284

N 33 degrees 34 minutes 25.1 Seconds

W 111 degrees 96 minutes 98 seconds



Y Fissure in Queen Creek Area

Photos taken by Ken Fiebelkorn, Town of Queen Creek

Fissure Gully Formation

Photos taken by Ken Fiebelkorn, Town of Queen Creek

Earth Fissure Impacting Utilities

Photos taken by Ken Fiebelkorn, Town of Queen Creek

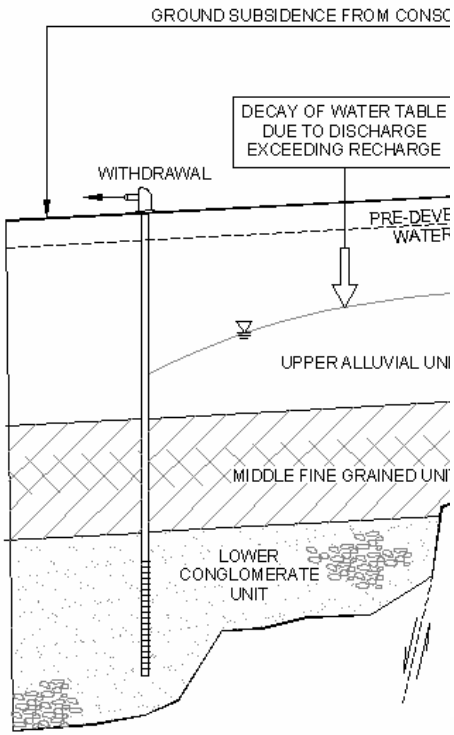
Earth Fissure Impacting Gas Line

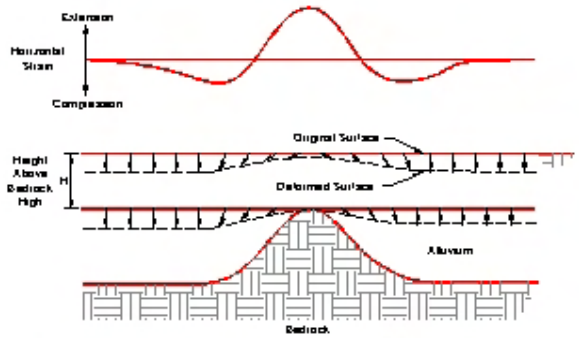
Overview of Ground Subsidence

- Mechanics
- Distribution
- Rate & Amount
- Probable Geologic/Hydrologic Controls
- Differential Subsidence
- Horizontal Strain

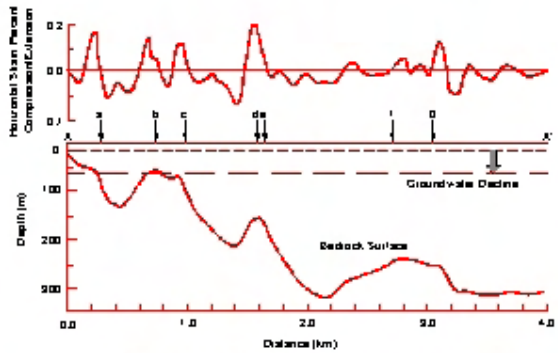
The Cause

Mechanics of Earth Fissuring

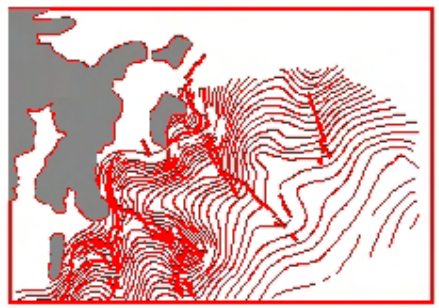




HORIZONTAL STRAIN PROFILE



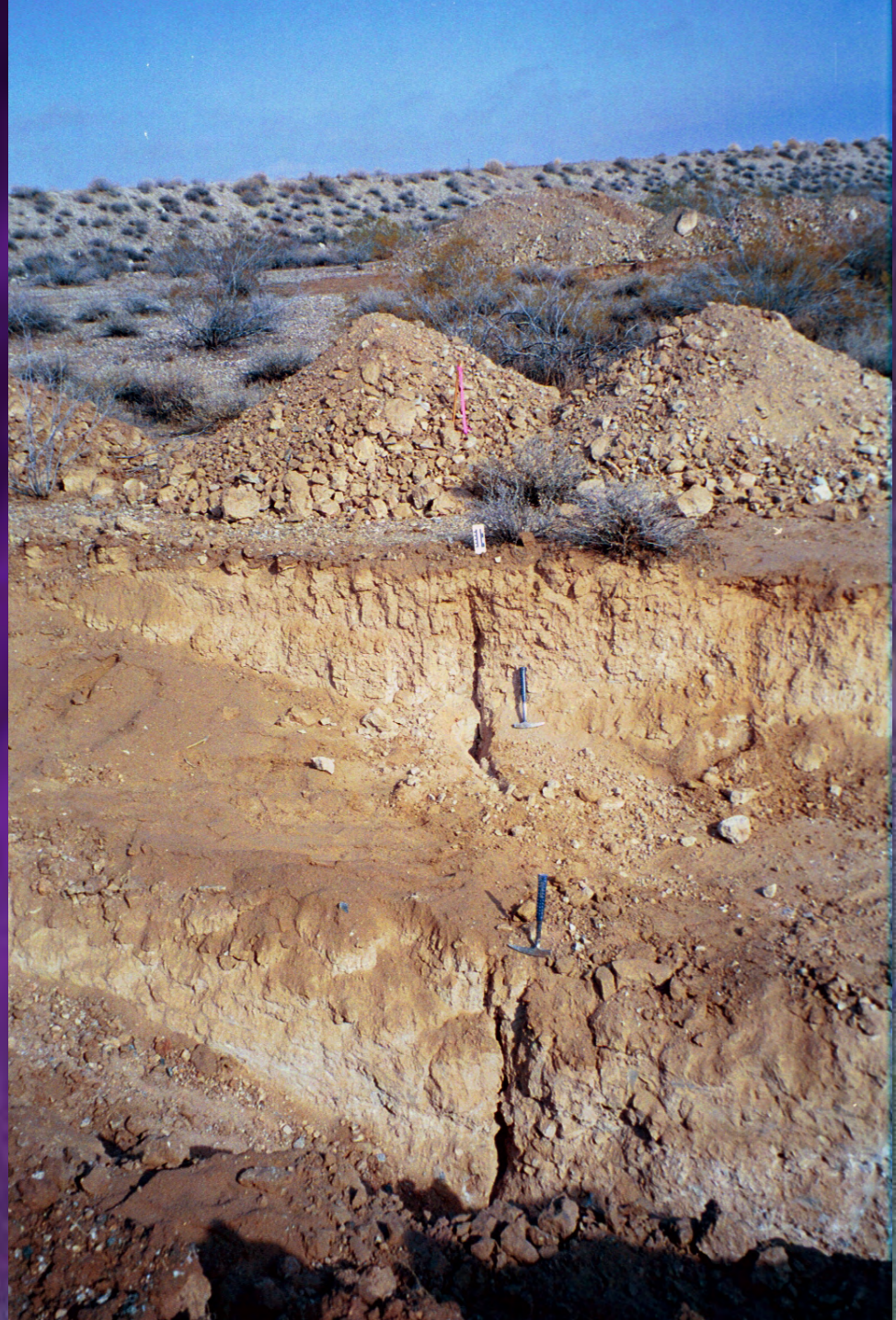
COMPRESSION/EXTENSION PROFILE



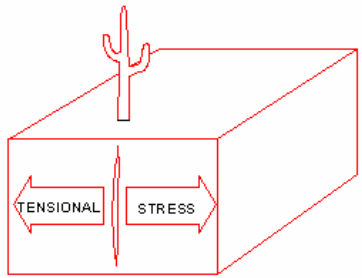
RELATIONSHIP BETWEEN FISSURES AND
BURIED BEDROCK SURFACE

NT

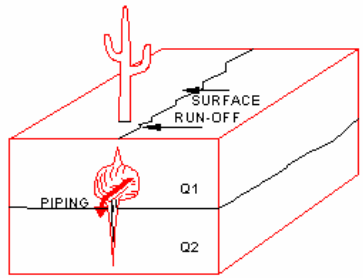
NOTE; ALL UNIT THICKNESS AND OTHER
GEOMETRIES SHOWN ARE
)NCEPTUAL AND DO NOT REFLECT ACTUAL
SURFACE CONDITIONS IN THE STUDY AREA



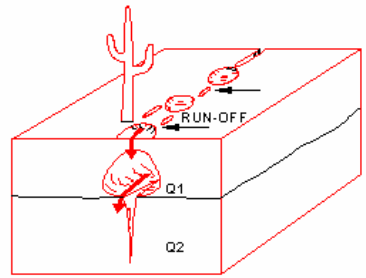
Earth Fissure Process



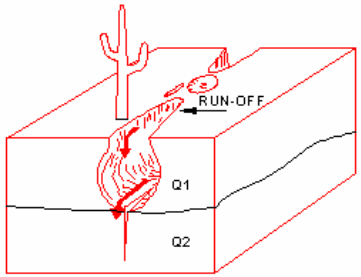
I. LATERAL STRESSES CAUSE TENSION CRACKING



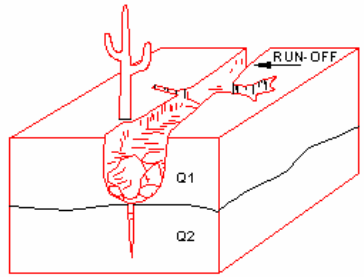
II. SURFACE RUNOFF AND INFILTRATION ENLARGE CRACK THROUGH SUBSURFACE PIPING



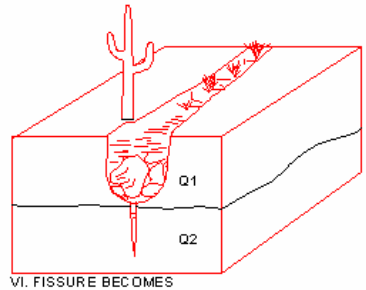
III. AS PIPING CONTINUES, FISSURE BEGINS TO APPEAR AT SURFACE AS SERIES OF POT HOLES AND SMALL CRACKS



IV. AS INFILTRATION AND EROSION CONTINUE, FISSURE ENLARGES AND COMPLETELY OPENS TO SURFACE AS TUNNEL ROOF COLLAPSES



V. THE ENTIRE FISSURE IS OPENED TO THE SURFACE AND ENLARGEMENT CONTINUES AS FISSURED WALLS ARE WIDENED; EXTENSIVE SLUMPING AND SIDE STREAM GULLYING OCCUR



VI. FISSURE BECOMES FILLED WITH SLUMP AND RUN-OFF DEBRIS AND IS MARKED BY VEGETATION LINEAMENT AND SLIGHT SURFACE DEPRESSION; IT MAY BECOME REACTIVATED UPON RENEWAL OF TENSILE STRESS

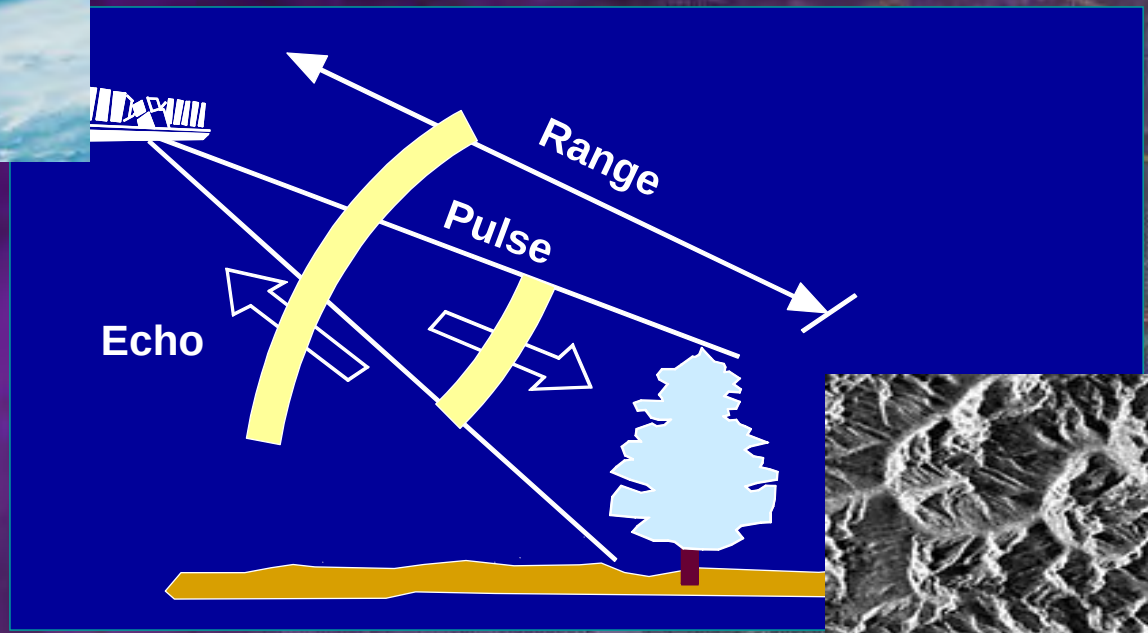
Earth Fissure Erosion

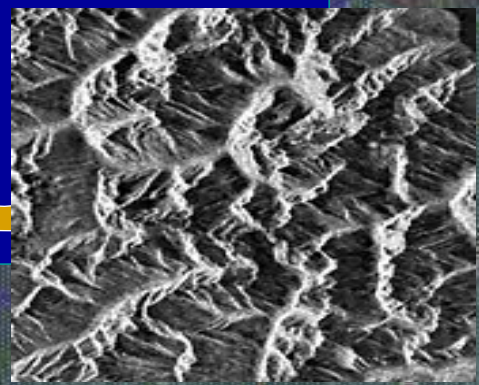
Investigation Process

- Review/Compilation of Existing Data
- Conventional and Low-Sun Angle Aerial Photography
- Ground Reconnaissance
- Acquisition of Interferometry
- Seismic Refraction Profiling
- Trenching

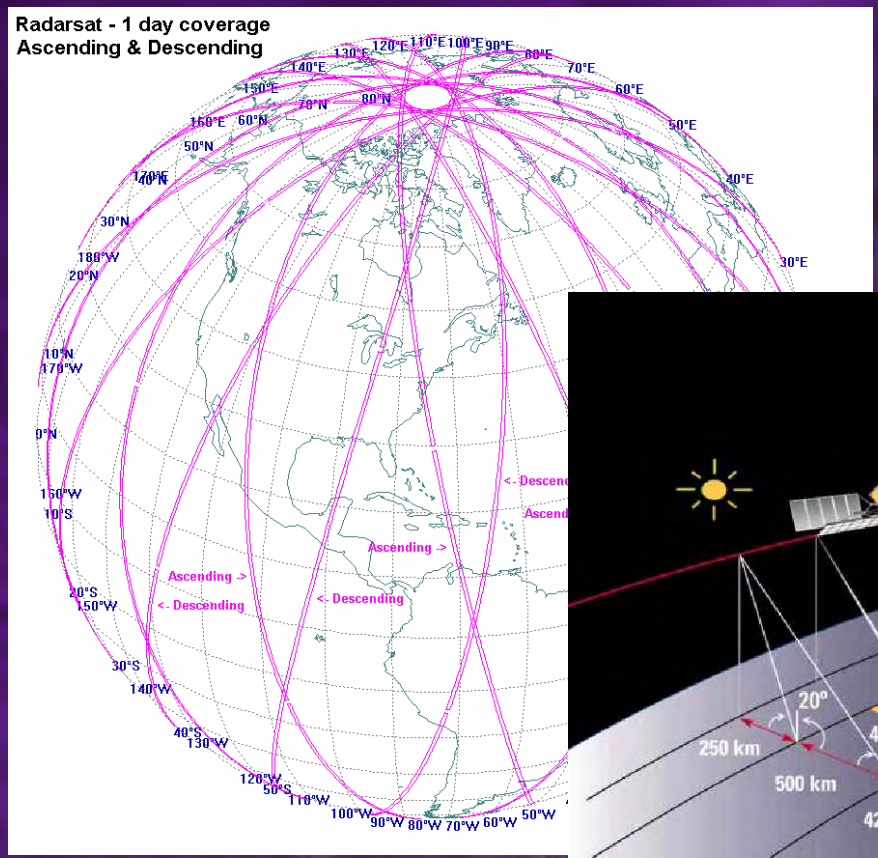
Earth Observation

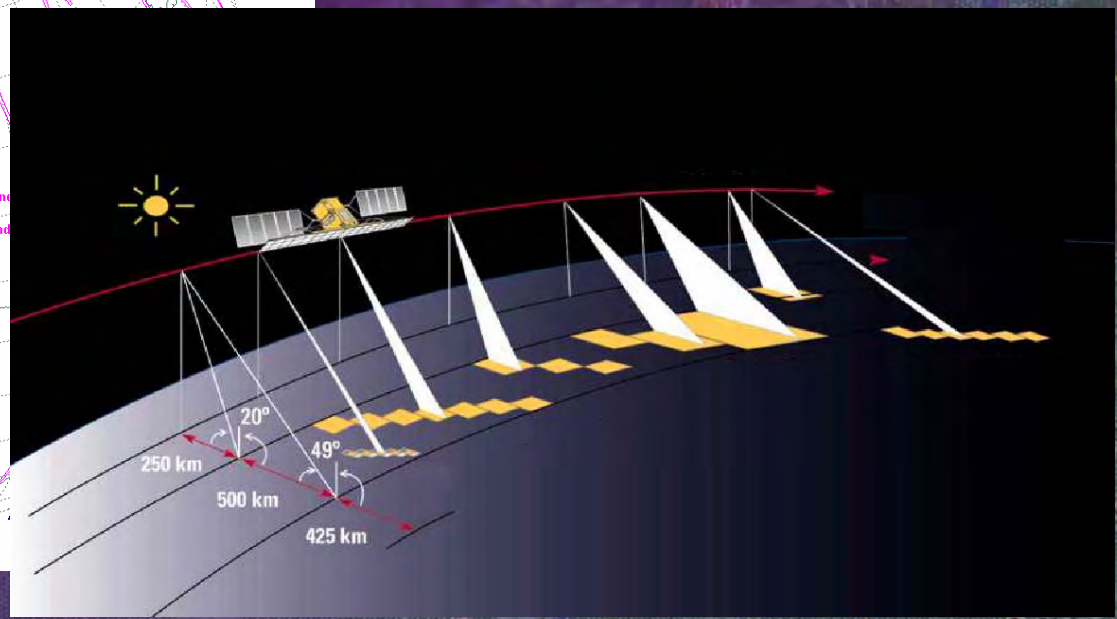
Satellite Interferometry

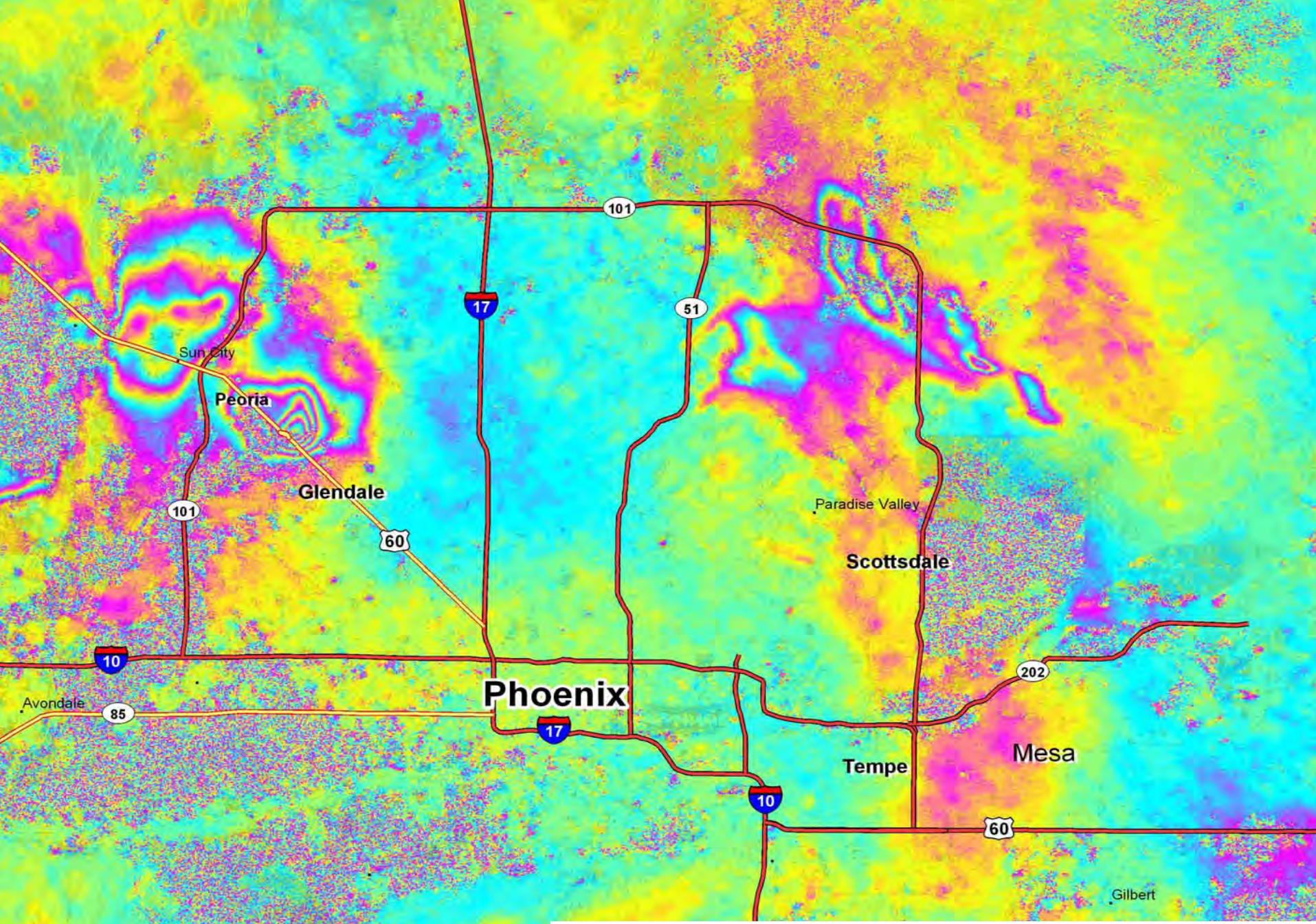




InSAR Data Acquisition







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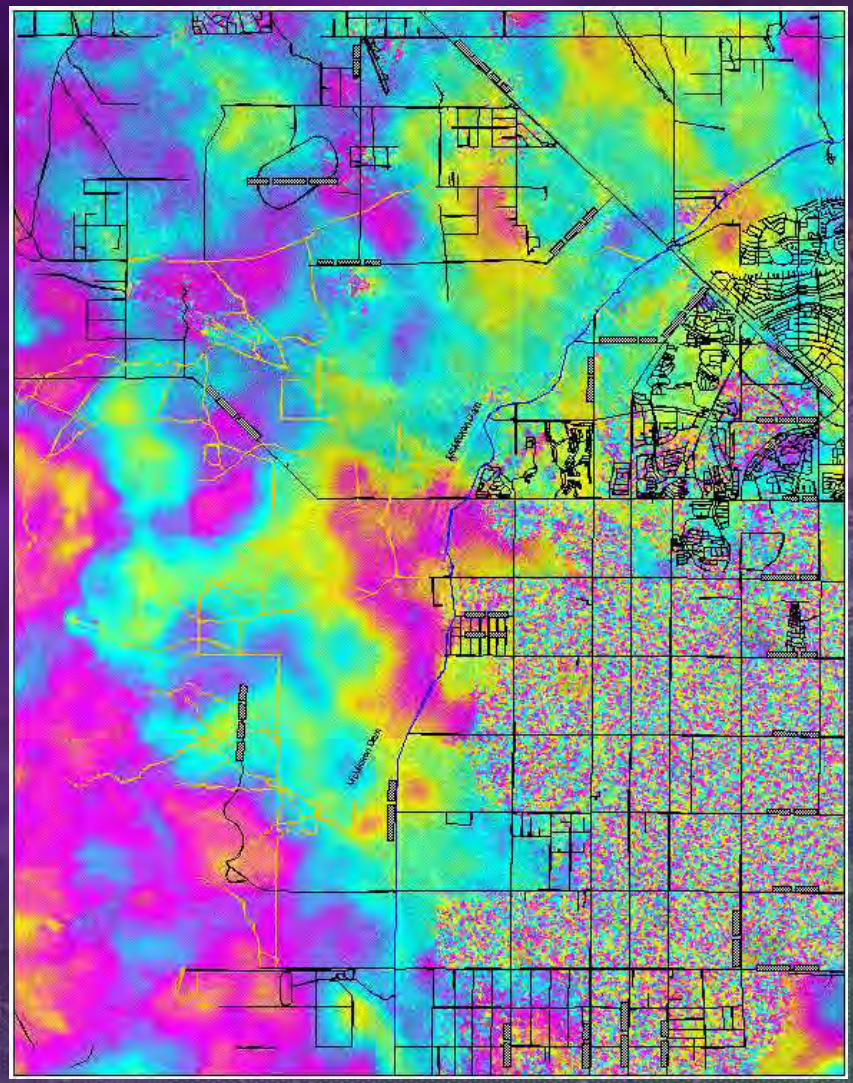
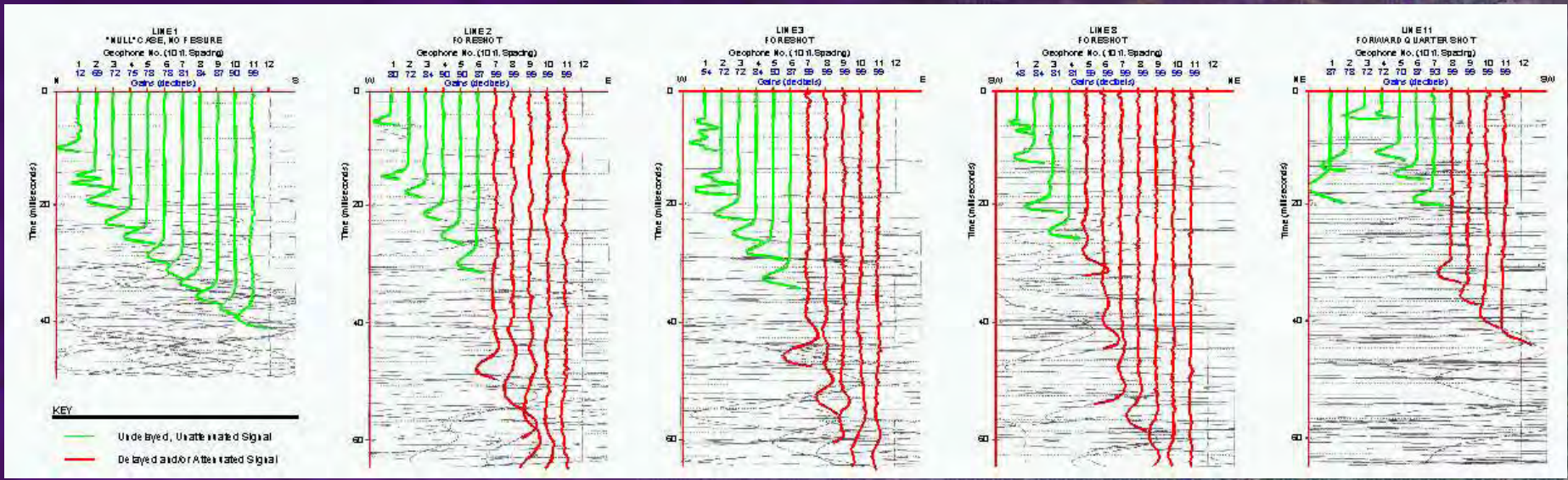
InSAR Interferometry of West Phoenix Valley



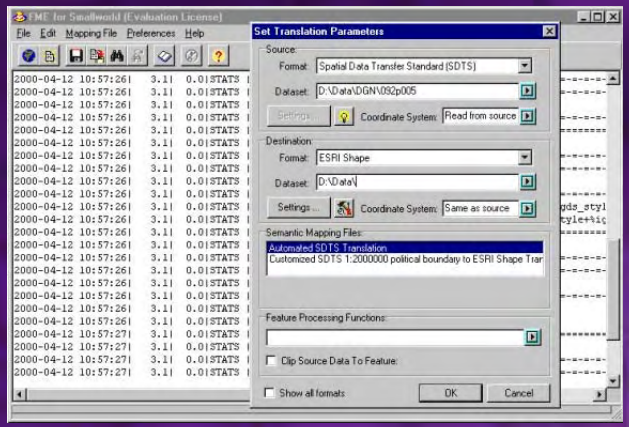
Seismic Refraction Profiling Method for Detecting Earth Fissures



Trenching Techniques Employed to Map Fissures

Application of GPS

Geospatial data integration…



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Risk Mitigation

- Locate hazard
- Define the risk
- Assess the impact
- Quantify tolerance
- Implement solutions
  - Planning
  - Defensive designs
- Monitor hazard

Thank You and Questions

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